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A PRODUCTIVE EFFICIENCY OF INPUT USES IN THE INDIAN CARPET INDUSTRY: STOCHASTIC FRONTIER APPROACH

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ABSTRACT

The carpet industry is an important and integral part of small scale and cottage industry of India, making positive contributions to employment, income and foreign exchange. The growth of the industry has been upward and thereby has acquired the first position in the exports of carpet in the global market. This study has tried to empirically investigate the Cobb-Douglas production function and stochastic frontier model for the carpet industry of India. The result shows that the coefficient of capital and labour are 0.38 and 0.56 respectively indicating the labour-intensive nature of the industry as well the decreasing returns to scale of the industry. The efficiency level of the industry on an average is not impressed with 39% average efficiency level, although the most efficient firm has an efficiency level of 89%. The industry needs proper support from government in order to eliminate the inefficiencies and bottlenecks faced by the industry.

KEYWORDS: ***Carpet Industry, Cobb-Douglas Production Function, Returns to Scale, Stochastic Frontier Analysis & India***

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1. INTRODUCTION

The development of any country depends on the level of its industrialisation. Industrialisation has been the most important element in the growth stories of almost all the developing nations since 1950s, India being one of such nations (Szirmai 2011). In this regard, India's need differs considerably. India is still a developing economy which is still hovered by problems such as poverty, unemployment, regional imbalances, etc. The need for industrialisation is evident but the method of industrialisation has to be different from developed economies. The role of Small scale industries is pivotal in the success story of industrialization (Ikechukwu 2014). Since the inception of independence, the thrust has been on industrialisation but special emphasis has been placed upon the role of small scale and village industries. These small scale and village industries play a special role by creating jobs in the rural and village areas thus keeping some check on the migration to the already crowded metropolitan cities. The small scale and cottage industries are pivotal in the growth process as they create employment, income and leads to the balanced development of rural and semi-urban areas. (Rahman 2006). These small scale and cottage industry helps in the generation of income, employment and net foreign exchange. These industries are the

medium to a more equitable distribution of income, effective mobilization of resources of labour and capital and also generate huge employment (Herald 1998).

The carpet industry of India is unique and is popular for its handmade carpets. The carpet industry is a labour-intensive industry and it would not be wrong to call labour the backbone of this industry. Thus, this industry meets a very important objective of the economy i.e. to provide employment to people. The carpet industry draws labour from the unorganised sector of the economy. This industry has an additional benefit; it provides additional earning to farmers and other labourers at their resident places (Steering Committee 2012). In Indian context, cotton weaving, silk weaving, carpet making, leather industry, metal handicrafts and small food processing industries are the top cottage industries (Joy and Kani 2013).

Among small scale and cottage industries, carpet industry holds an important position. This industry ranks first in the world as a producer and exporter of handmade carpets and contributes about 4 percent of the exports of India (Annual Report 2014-15).

2. REVIEW OF LITERATURE

The small-scale industry has always been an important and integral part of the Indian economy. Though small-scale industry in India is labour intensive, but yet it has a high level of productivity of capital and even more than capital intensive techniques itself. The small-scale industry sector is crucial in the economic development as it generates income by providing employment, promotes balanced regional growth as well as earns foreign exchange for the country. This sector is of great relevance to the country as having the capability to compete in the global market due to its low cost of production as well as the quality of the product (Suresh and Shashidar 2007). Recommendation for the adoption of a strategy based on mainly labour-intensive techniques of production in the least developed countries on the ground that the large volume of unutilized labour possessed by these countries has a productive potential, capable of creating capital and increasing production (Myrdal 1968). To find out the technical efficiency of small and medium firms by employing the technique of stochastic frontier (Radam et al 2008) have been taken data for 7360 firms and result shows that the difference between observed and frontier output are mainly due to technical inefficiency and the maximum estimated technical efficiency is 97.10 percent and the minimum is 0.30 per cent while the mean technical efficiency is 52.62 percent. A firm with 82 percent efficiency is considered as efficient firm and thus in this case only 3.06 percent of total Small Manufacturing Enterprises (SME) is efficient. The mean efficiency of micro, small and medium firms are 43.72 per cent, 54.35 per cent and 53.71 per cent respectively. High standard deviation for medium enterprises shows generally low performance even though the maximum efficiency index is 97.10. The study has kept the efficiency index too high and thus just a few firms have emerged as efficient. (Ismail et al 2014) in their study has tried to find out the technical efficiency level of SMEs in the Malaysian manufacturing firms. The analysis uses the data obtained from the Department of Statistics of Malaysia 2009 Manufacturing Survey, which covers 4661 SMEs. The study has used the frontier production model to achieve the objective. The adaptation of the translog production model was made to obtain the technical efficiency scores and the linear technical inefficiency model to determine factors affecting the firms' inefficiency level. The results reveal a very low level of allocation on Research and Development (R & D) in all three categories of firms. The mean ratio of workers with upper secondary, lower secondary education, technical workers, and general workers are 0.378, 0.577, 0.383 and 0.7228 respectively. The mean of the technical efficiency for the whole sample is 0.655. Micro firms have least technical efficiency. The majority of the firms are at the efficiency level of between 0.70-0.79. The electrical and

electronics industry is the most efficient with the TE score of higher than 0.733 followed by the transport equipment. Heavier industries are relatively more efficient than the light industries. For the micro and small firms, the most significant determinant of their technical inefficiency with the largest negative coefficient is Information and Communication Technology (ICT) expenditure, but for the SMEs the training expenditure is reducing their technical inefficiency level. This implies that micro firms still require less educated workers to equip with their low technological level. (Babar 2012) in his research work highlights the importance of small scale industry. The study reveals the great potential of small scale industries in terms of employment opportunity, contribution to the growth rate of the economy as well as earning of foreign exchanges. The production of small scale industries has been significant and shows the highest growth rate of 42.49% in 2001-2002. The employment level is also very high. According to the third census of SSIs conducted with reference to the year 2001-2002 was 249.33 lakh numbers. Small scale industrial sector of India also contributes to a huge extends to exports. The exports from small scale units contribute to around 45%-50% of total exports thus contributing to a great extend in the country's economic development. The direct export from small scale industry is nearly around 35%, whereas the indirect exports from small scale industry nearly account for 15%. (Muniyandi and Vadivel 2016) in their work explored the level of return to scale of the manufacturing sector in Tamil Nadu by making use of data from the Annual Survey of Industries (ASI) from 1980-81 to 2007-08. The results showed that the manufacturing industries in Tamil Nadu are performing well as they are operating under increasing returns to scale. This indicates the positive growth of these manufacturing sectors. (Husain and Islam 2016) investigated the nature of six major manufacturing industries in Bangladesh through the application of Cobb-Douglas production function. The overall selected manufacturing sector has a coefficient of capital and labour of 0.49 and 0.51 respectively. Capital was more productive in pharmaceutical sector, food and food processing industries, electronics and chemicals while garments, leather and leather products and textile industry were more labour intensive in nature. The overall manufacturing sector in Bangladesh was operating on increasing returns to scale. (Admassie and Matambalya 2002) has tried to investigate the level of technical efficiency of small scale and medium scale enterprises in Tanzania. The study was based on the primary data collected from 1999 to 2000 and the said objective is being tested through the application of Cobb-Douglas stochastic frontier production function. The study shows that the SMEs of Tanzania is suffering from high technical inefficiency which has a negative impact on the growth of the industry.

3. DATA COLLECTION

This study is based on the primary data collected from the two districts of Eastern Uttar Pradesh namely, Bhadohi and Mirzapur. The reason for the selection of this two-particular district of Uttar Pradesh is that around 80% of the production of carpet takes place in these two districts with the capacity to export almost all of its product (carpet encyclopaedia). The data has been collected through a structured questionnaire from the carpet belt of India i.e. Bhadohi and Mirzapur which covered 96 firms.

4. APPLICATION OF COBB-DOUGLAS PRODUCTION FUNCTION:

The most important challenge which every producer faces in any industry is to increase output at the minimum cost. The same is true for the producers and exporters of Indian carpets. For this, one must know how efficiently or inefficiently the manufacturers are using scare inputs, then measures can be suggested to efficiently use such inputs to increase production and also minimize cost. Production function analysis is one of the suitable methods to find out the efficient use of the inputs in the production. The production function analysis gives an explicit idea regarding the use of

inputs and their influence on the output. The production function analysis determines the productivity levels of the different inputs and assesses the contribution at the margin to the output. Cobb-Douglas production function has been applied in order to establish the input-output relationship among the exporters covered in the study.

The application of Cobb-Douglas production function in carpet production can be justified in two different ways (1) computational manageability with this algebraic form and (2) the information regarding returns to scale which provides theoretical fitness to the carpet industry. The Cobb-Douglas production function has been estimated using an ordinary least square method of regression. The possibility of increasing carpet output is examined by estimating production elasticities of input.

4.1 Specification of the Model

The study has tried to establish the relationship between inputs and output of carpet industry of India. One of the task of the study is to know the nature of the carpet industry i.e. Whether an Indian carpet industry is labour intensive or capital intensive in nature, although like all the handicraft and cottage industry carpet industry too is regarded as a labour-intensive industry. But for a researcher, it is important to check these notions through tests as sometimes completely different outcomes are being encountered. To test whether the carpet industry is labour intensive or capital intensive, Cobb-Douglas production function has been applied. Through the application of Cobb-Douglas, elasticity of production inputs has been estimated. The parameter estimates of the Cobb-Douglas model indicates the following:

- Production elasticities of respective inputs
- Intensities of factor used
- The sum of input elasticities estimates (when the sum not significantly different from unity) returns to scale.

The relationship between inputs and output can be established through the production function. One of the best ways to discover the productivity is the application of the Cobb-Douglas production function, widely used due to its simple form which is easily understood. The basic model of the Cobb-Douglas production function has two inputs which are labour and capital and the sum of elasticity of labour and capital is one which means Cobb-Douglas has constant returns to scale. This model has been expressed as:

$$Q_i = Z\, L_i^{\alpha} K_i^{\beta} \tag{1}$$

Where Q = gross value of output, L = expenditure on labour inputs, K = expenditure on capital inputs, and Z is a constant.

It can be seen that the above model is nonlinear in parameter which might create hurdles in the estimation. The best way to deal with it is make this function linear through transforming the model in logarithm. The following model is obtained through the application of log in the initial model:

$$\ln Q_i = \ln Z + \alpha \ln L_i + \beta \ln K_i \tag{2}$$

Where ln represents natural logarithm.

Writing ln Z = A, now we can rewrite equation (2) as:

$$\ln Q_i = A + \alpha \ln L_i + \beta \ln K_i \tag{3}$$

Now, equation (3) is linear in the parameters A, α, and β and is, therefore, a linear equation, although it is nonlinear in the variables Q, L and K.

Adding the stochastic term u_i to equation (3), we obtain the following Linear Regression Model (LRM):

$$\ln Q_i = A + \alpha \ln L_i + \beta \ln K_i + u_i \tag{4}$$

Equation (4) has log on both the sides i.e. on both dependent and independent variables and therefore this model is called log-log or double log model and the slope coefficients can be interpreted as elasticities for independent variables. The slope coefficient α is the partial elasticity of output with respect to the labour input, holding all other variables (here capital, or K) constant because it gives the percentage change in the output for the percentage change in the labour input, ceteris paribus. Similarly, the slope coefficient β is the partial elasticity of output with respect to the capital input, holding other inputs constant.

An interesting advantage of these elasticities is that they are pure numbers, that is, devoid of units in which the variables are measured because they are ratios of percentage changes.

Another advantage of Cobb Douglas function is that the sum of the partial slope coefficients, (α+β), gives information about returns to scale, that is, the response of output to a percentage change in the inputs.

The production function is purely a technical concept, which expresses the physical relationship of maximum quantities of well-defined physical output obtainable from the technologically feasible combinations of equally well-defined factors under given the state of technology. The definition, measurement of different dependent and independent variables are as follows:

- **Output**

  The gross value of output valued at prices received by the manufacturers. Data for the gross value of output was collected for three consecutive years which was 2013, 2014 and 2015 from the firms. The dependent variable of our study is the average of gross output of these three years.

- **Labour**

  The variable labour is taken by considering the total expenditure on labour inputs made into a single variable and is specified in the terms of eight-hour man days.

  The assumed differences in the efficiency of labour between male and females are standardized. The female days are converted into man days taking the wage rates as a base. In the surveyed areas, as per the wagerates, three female days are equal to two-man days.

- **Capital**

  The expenditure on capital inputs is also aggregated into a single variable and it is measured in terms of depreciation allowances, maintenance charges on firm equipment, interest charges, electricity charges, the cost of fuel etc.

5. PRODUCTION ELASTICITIES OF FIRM INPUTS

To illustrate the Cobb Douglas production function, we used data on output (as measured by gross value output, in millions of Indian rupees), labour (expenditure on labour inputs, in millions of Indian rupees), and capital (expenditure on capital inputs, in millions of Indian rupees) for the Indian carpet industry.

Table 1: The OLS Regression Results

Source	SS	df	MS			
Model	25.3929793	2	12.6964896	Number of obs = 96 F(2, 93) = 65.07 Prob > F = 0.0000 R-squared = 0.5832 Adj R-squared = 0.5743 Root MSE = .44171		
Residual	18.1449441	93	.195106925			
Total	43.5379233	95	.45829393			
In output	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
In labour	.562614	.0910859	6.18	0.000	.3817355	.7434926
In capital	.3845319	.0413002	9.31	0.000	.3025179	.466546
_cons	7.454333	.1756502	42.44	0.000	7.105527	7.80314

The important point to notice is that both the regression coefficients (i.e. elasticities) are individually statistically significant for the p values are quite low (or practically zero). On the basis of F statistic, we can conclude that collectively the two independent variables (labour and capital), are highly statistically significant because its p value is very low (or practically zero). The R^2 value of 0.583 is also quite high for cross sectional data, which shows the goodness of fit of the model.

The interpretation of the coefficient of the labours of about 0.56 is that if we increase the labour input by 1%, on average, output goes up by about 0.56%, holding the capital input constant. Similarly, holding the labour input constant, if we increase the capital input by 1%, on average, the output increases by about 0.38%. Relatively speaking, it shows a percentage increase in the labour input contributes more towards the output than a percentage increase in the capital input.

The returns to scale can be measured by summing up the coefficient of labour and capital and in this study the summation of the slopes of the coefficients of labour and capital is coming less than 1 which indicates that the carpet industry of India is working under decreasing returns to scale.

Table 2: Production Elasticities of Inputs Based on the Firm's Size

	Intercept	Labour	Capital	Sum of Elasticity Coefficients	R2	Adjusted R2
Small Manufacturers						
Coefficient	7.670	0.352*	0.076	0.428	0.470	0.424
SE		0.078	0.050			
T-value		4.510	1.510			
Medium Manufacturers						
Coefficient	8.481	0.204***	0.190*	0.394	0.397	0.369
SE		0.115	0.040			
T-value		1.770	4.710			
Large Manufacturers						
Coefficient	8.743	0.237	0.288*	0.525	0.326	0.252
SE		0.159	0.112			
T-value		1.490	2.570			

Source: Primary Survey
* Significant at 1 Percent Level
** Significant at 5 Percent Level
*** Significant at 10 Percent Level

The production elasticities of inputs of three different firm size groups are given in table 2. These firm size groups are based on the firm's gross value of output. The separate Cobb-Douglas production function is used for each size group and the value of multiple determinants indicate that the independent variables explain about 47 percent, 40 percent and 33 percent for small, medium and large firms respectively. In the case of small firms, the value of R^2 is comparatively higher than other firm size groups. The sum of production elasticities is not close to unity revealing decreasing returns to scale.

In the case of small manufacturers, the elasticity coefficient of labour is statistically significant at a probability level of 1 percent. While in the case of medium manufacturers, both coefficients are statistically significant at 10 percent and 1 percent level of significance of labour and capital inputs respectively. For large manufacturers, the coefficient of capital input is statistically significant at 1 percent level of significance.

6. STOCHASTIC FRONTIER PRODUCTION AND EFFICIENCY MEASUREMENT

The Stochastic Frontier Approach has been used to estimate technical efficiency. Inefficiency has been characterized as the separation between the actual value of a firm's carpet production and the estimated frontier carpet production value that refers to the condition of its production technology. As used in the Cobb-Douglas production function, the gross output value was used as the dependent variable, while labour and capital inputs were used as the explanatory variables to explain efficiency in the model when estimating technical efficiency measures.

Suppose a carpet manufacturer has a production function $f(z_i, \beta)$. In a world where there is no error or inefficiency, the *i*th firm would produce

$$q_i = f(z_i, \beta)$$

Analysis of the stochastic frontier assumes that each firm potentially produces less than could be due to a degree of inefficiency. Specially,

$$q_i = f(z_i, \beta)£_i$$

where $£_i$ is the efficiency level for firm i; $£_I$ must be in the range (0,1). If $£_i = 1$, the firm achieves optimal performance with the technology embodied in the production function $f(z_i, \beta)$. When $£_i < 1$, the firm is not taking advantage of the inputs z_i because of the technology embodied into the production function $f(z_i, \beta)$. Since the output is considered strictly positive (i.e., $q_i > 0$), the degree of technical efficiency is considered strictly positive (i.e., $£_i > 0$).

It is also assumed that production is subject to random shocks, which implies that

$$q_i = f(z_i, \beta)£_i \exp(v_i)$$

Taking the natural log of both sides:

$$\ln(q_i) = \ln\{f(z_i, \beta)\} + \ln(£_i) + v_i$$

Assuming that there are k inputs and that the production function is linear in logs, defining $u_i = -\ln(£_i)$ yields

$$\ln(qi) = \beta o + \sum_{j=1}^{k} \beta j \ln(zji) + vi - ui$$

Since $u_i$is subtracted from *ln* (q_i), restricting $u_i \geq 0$ implies that $0 < £_i \leq 1$, as specified above.

Different details of the u_i and v_i terms give different patterns. Frontier provides estimators for the parameters of three basic models in which the eccentric component, v_i, is considered independently N(0; σ_v) distributed in the observations. The fundamental models vary in their specificity of the inefficiency term, u_i, as follows:

- **Exponential:** The u_i are independently exponentially distributed with variance σ^2_u.
- **Half Normal:** The u_i are independently half-normally N+(0; σ^2_u) distributed.
- **Truncated Normal:** The u_i are independently N+(μ; σ^2_u) distributed with truncation point at 0.

For half-normal or exponential distributions, frontier can be adapted to models with heteroskedastic error components, conditional on a set of covariates. For a truncated-normal distribution, frontier can also fit a conditional mean model where the mean is modelled as a linear function of a set of covariates.

6.1 The Half-Normal and the Exponential Models

The variable lnoutput is the log-transformed gross output value, lnlabour is the log-transformed labor, and lncapital is the log-transformed capital. OLS estimates can be compared with those from stochastic frontier models using both the half-normal distribution for the inefficiency term.

Table 3: Stochastic Frontier Model (half normal) using Maximum Likelihood Method

Stoc. frontier normal/half - normal model Log likelihood = -53.012765				Number of obs = 96 Wald chi2 (2) = 167.43 Prob > chi2 = 0.0000		
in output	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**[95% Conf. Interval]**	
in capital	.3929537	. 0351837	11.17	0.000	. 3239948	. 4619125
in labour	.5379699	.0906374	5.94	0.000	.3603239	. 7156158
_cons	7.915575	. 1859962	42.56	0.000	7.551029	8.280121
/in sig2v	-2.626706	.3391103	- 7.75	0.000	-3.29135	-1.962061
/in sig2u	-1.184363	.3030543	-3.91	0.000	-1.778338	-.5903871
sigma_v	.2689169	. 0455963			.1928824	.3749245
sigma_u	.5531194	.0838126			. 4109971	. 7443875
sigma2	.3782574	.0811256			.2192541	.5372607
lambda	2.056841	. 1161943			1.829105	2.284578
Likelihood-ratio test of sigma_u=0: chibar2 (01) = 6.48 Prob > = chibar2 = 0 .0 05						

The output from frontier includes estimates of the standard deviations of the two error components, σ_v and σ_u, which are labelled sigma_v and sigma_u, respectively. In the log likelihood, they are parameterized as $\ln\sigma^2_v$ and $\ln\sigma^2_u$, and these estimates are labelled /lnsig2v and /lnsig2u in the output. Frontier also reports two other useful parameterizations. The estimate of the total error variance, $\sigma^2_S = \sigma^2_v + \sigma^2_u$, is labelled sigma2, and the estimate of the ratio of the standard deviation of the inefficiency component of the standard deviation of the idiosyncratic component, $\lambda = \sigma_u/\sigma_v$, is labelled lambda.

At the bottom of the output, frontier reports the results of a test that there is no component of technical inefficiency in the model. This is a test of the null hypothesis $H_0 : \sigma^2_u = 0$ with respect to the alternative hypotheses H1 : $\sigma^2_u > 0$. If the null hypothesis is true, the stochastic frontier model is reduced to an OLS model with normal errors. However, because the test is on the edge of the parameter space of σ^2_u, the standard likelihood-ratio test is not valid, and a

one-sided generalized likelihood-ratio test must be constructed. In our study, the output shows LR = 6.48 with a p-value of 0.005 for the half-normal model and LR = 9.01 with a p-value of 0.001 for the exponential model.

The table 3 shows the estimated coefficients for the frontier model using maximum likelihood estimate (MLE) methods. The production elasticity of improved carpet production conducted by carpet manufacturers is positive and significant as expected. The elasticity of labour and capital resources are positive and highly significant. Thus, the increasing investment by 1 percent on labour inputs could increase the carpet production by 0.54 percent, similarly, an increasing investment by 1 percent on capital inputs could raise the carpet production by about 0.39 percent. The results show that investment in labour could bring a significant improvement to the performance of carpet production because carpet industry is a labour intensive and skill driven industry. This implies that investment in labour input remains a major contributor to the improvement of technical efficiency in carpet production practiced in the Bhadohi and Mirzapur districts. The overall technical inefficiency effects are evaluated in terms of the parameters associated with σ^2 (sigma square) and λ (lambda). The estimate for the variance parameters σ (sigma) is significantly different from zero at 1 percent level of significance.

Table 4: Deciles Range of Frequency Distribution of Technical Efficiency of the Carpet Manufacturers

Efficiency Level	Frequency	Percentage
< 0.10	1	1.04
0.11-0.20	9	9.38
0.21-0.30	31	32.29
0.31-0.40	21	21.88
0.41-0.50	9	9.38
0.51-0.60	8	8.33
0.61-0.70	3	3.13
0.71-0.80	8	8.33
0.81-0.90	6	6.25
0.91-1.00	0	0.00
Total	96	
Minimum	0.079	
Maximum	0.863	
Mean	0.393	
Standard Deviation	0.203	

The frequency distribution of firm specific efficiency scores for the carpet manufacturers is shown in the above table 4. The interesting result is that the efficiency score of the carpet firms is ranging widely from 8% to 86%. It is worth noting, however, that this wide variation is unique or not is ambiguous because we didn't find similar studies for carpet industry in India. The average efficiency for the Indian carpet industry was 39%. This implies that the average manufacturer in the study area could increase gross output value by 61 percent to attain frontier by improving their technical efficiency. However, the least gross output value efficient manufacturer needs an efficiency gain of 91 percent [i.e. (1.00 – 0.079/0.863)*100] in the use of specified firm resources if such manufacturer is to attain the gross output value efficiency of the best manufacturer in the region. Likewise, for an average efficient manufacturer, he will need an efficiency gain of 54 percent [i.e. (1.00 – 0.393/0.863)*100] to attain the level of the most gross output value efficient manufacturer. Also, the most gross output value efficient manufacturer needs about 14 percent gains in gross output value efficiency to be on the frontier. In spite of this, the results implied that a considerable amount of gross output value can be obtained by improving their technical efficiency in the carpet industry.

7. CONCLUSIONS

From the findings of the study, it can be concluded that the carpet industry of India is indeed a labour-intensive industry. The Cobb-Douglas Production function shows that the co-efficient of capital and labour are 0.38 and 0.56 respectively. But what is disturbing is the fact that the industry is working on decreasing returns to scale. It means that the increase in the production is less than the increase in the input resources i.e. capital and labour. Further, the firms are being divided into three different groups in accordance with their size, small, medium and large firms. Among these three only large firms is capital intensive in nature.

The study also found that the industry is working below efficiency level. The result shows that by increasing investment by one percent on labour inputs will raise the carpet production by 54 percent, similarly, an increasing investment by one percent on capital inputs could raise the carpet production by about 39 percent. The study clearly depicts the relevance and importance of the labour in the industry. In many manners, the industry relies on the shoulders of labour.

The interesting result is that the firms' efficiency is ranging from 8% to 89%. But the average efficiency is only 39%. The most efficient firm needs to improve only 14%, whereas the worst performing firm needs a gigantic improvement of 91%. An average firm needs 54% improvement to be on the frontier. Thus, it is very important to note the wide difference in the level of efficiency of different firms. There is a huge need to address the problems faced by the small firms within the industry.

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